Methow Spring Chinook Population

The Methow spring Chinook population is part of the Upper Columbia ESU. This ESU contains only one extant MPG including 3 current populations—Wenatchee, Entiat, and Methow Rivers, and one extinct population, the Okanogan (ICTRT 2004). For general descriptions of the subbasins and life history characteristics of these populations see NPPC (2004) or the Upper Columbia Recovery Plan (UCSRB 2006).

The ICTRT classified the Methow River spring Chinook population as "very large" in size based on historical habitat potential (ICTRT 2005). This classification requires a minimum abundance threshold of 2000 wild spawners with sufficient intrinsic productivity (greater than 1.75 r/s) to exceed a 5% extinction risk on the viability curve (ICTRT 2005). Additionally, the Methow spring Chinook population was classified as a "type B" population (based on historic intrinsic potential) because it has dendritic tributary structure with multiple major spawning areas (ICTRT 2005).

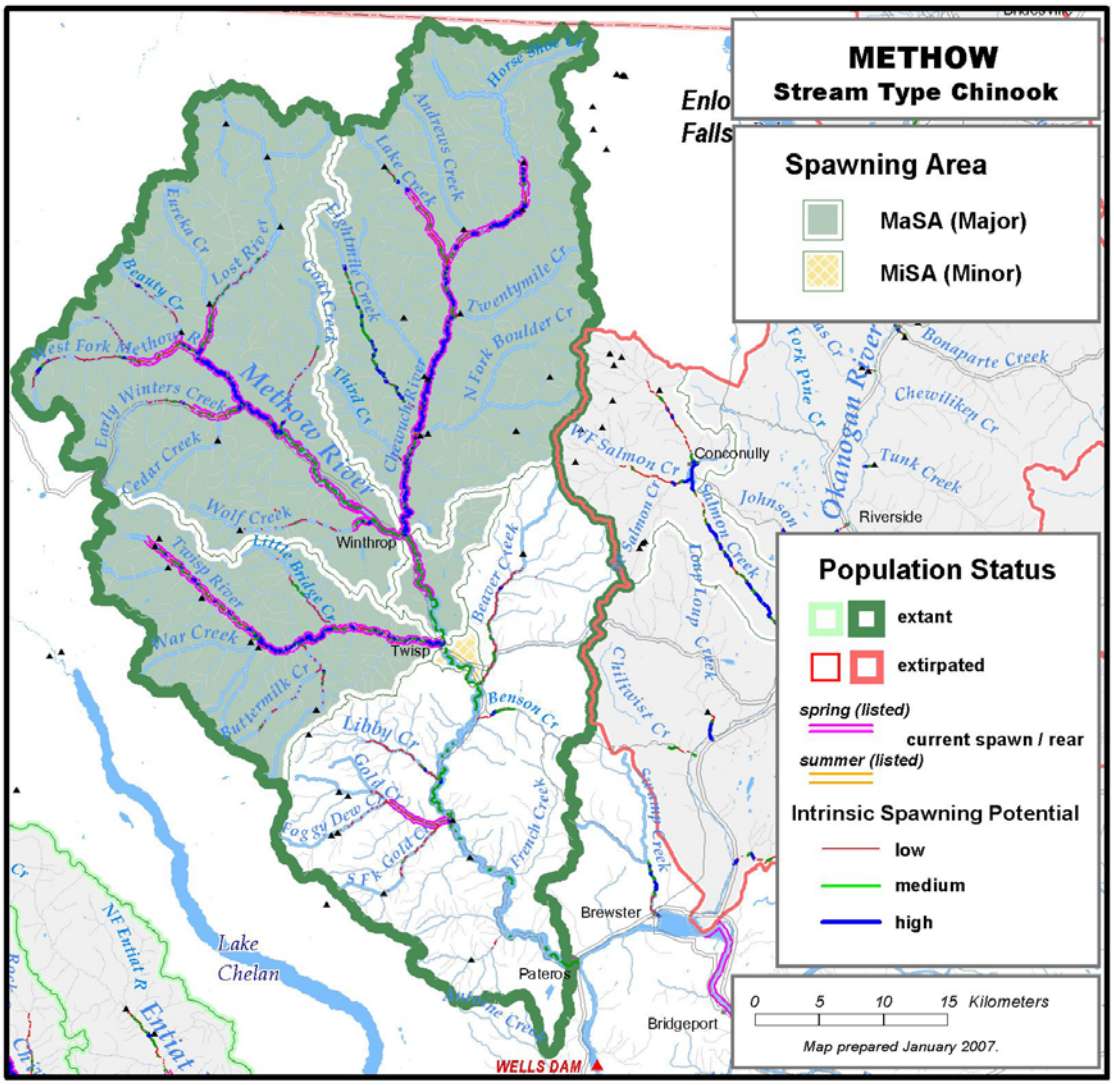

Figure 1. Methow River Spring Chinook population boundaries and major and minor spawning areas.

Table 1. Methow Spring Chinook Basin Statistics

Drainage Area (km2)	4,722
Stream lengths km* (total)	1,996.0
Stream lengths km* (below natural barriers)	889.0
Branched stream area weighted by intrinsic potential (km2)	1.497
Branched stream area km2 (weighted and temp. limited)	1.310
Total stream area weighted by intrinsic potential (km2)	2.036
Total stream area weighted by intrinsic potential (km2) temp limited	1.725
Size / Complexity category	Very Large / B (dendritic structure)
Number of MaSAs	4
Number of MiSAs	1

*All stream segments greater than or equal to 3.8m bankfull width were included

**Temperature limited areas were assessed by subtracting area where the mean weekly modeled water temperature was greater than 22^{o}C.

Current Abundance and Productivity

Current (1960 to 2003) abundance (number of adult spawning in natural production areas) has ranged from 4,927 in 1966 to 34 in 1995 (Figure 2). Abundance estimates are based on expanded redd counts (relatively complete coverage, temporal and spatial components).

Recent year natural spawners include returns originating from naturally spawning parents, and from the Winthrop National Fish Hatchery (since 1941, and continuously since 1974) as well as the Methow Hatchery (designed as a direct natural supplementation program). Spawners originating from naturally spawning parents have comprised an average of 33% over the recent (5-year) brood cycle. The most recent 10 year average contribution of naturally produced returns on the spawning grounds has been 52% (Table 2), ranging from 8% to 96%.

Abundance in recent years has been highly variable; the most recent 10-year geomean number of natural spawners was 205 (425 for total spawners). During the period 1960-1999, returns per spawner for spring chinook in the Methow subbasin ranged from 0.05 to 4.14. The most recent 20-year (1987-1998) geometric mean of returns per spawner (SAR adjusted and delimited at 75% of the size threshold) was 0.88 (Table 2).

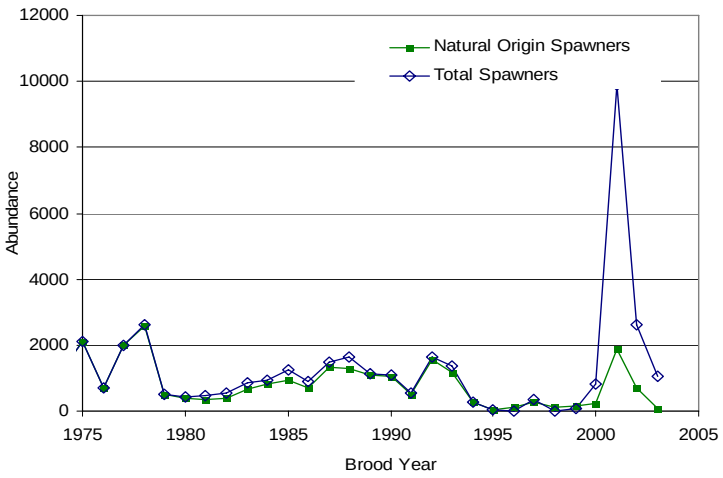

Figure 2. Methow Spring Chinook abundance trends from 1960 to 2003.

Table 2. Methow Spring Chinook abundance and productivity measures

10-year geomean natural abundance	205
20-year return/spawner productivity	0.74
20-year return/spawner productivity, SAR adj. and delimited*	0.88
20-year Bev-Holt fit productivity, SAR adjusted	2.16
Lambda productivity estimate	1.10
Average proportion natural origin spawners (recent 10 years)	52%
Reproductive success adj. for hatchery origin spawners	No data available

*Delimited productivity excludes any spawner/return pair where the spawner number exceeds 75% of the threshold for this population. This approach attempts to remove density dependence effects that may influence the productivity estimate.

Comparison to Viability Curve

- Abundance: 10-year geomean Natural Origin Returns
- Productivity: 20-year geomean R/S, SAR adjusted and delimited at 1500 spawners
- Curve: Hockey-Stick curve
- Conclusion: Methow Spring Chinook population is at **HIGH RISK** based on current abundance and productivity. The point estimate for abundance and productivity is below the 25% risk curve.

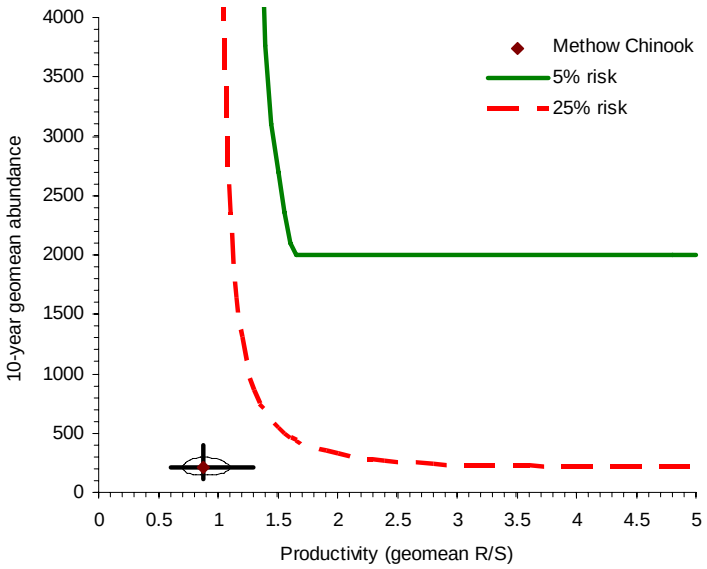

Figure 3. Methow River Spring Chinook abundance and productivity metrics against a Hockey-Stick viability curve. Point estimate shown with a 1 SE ellipse, 1.81 X SE abundance line, and 1.75XSE productivity line.

Spatial Structure and Diversity

The ICTRT has identified four historical Major Spawning Areas (MaSAs) and one minor spawning area (MiSA) within the Methow population. The four MaSAs are: Chewuch, Upper Methow, Middle Methow, and Twisp.

Currently, the primary spawning areas used by Spring Chinook in the Methow population are the mainstem Methow (above the Twisp confluence), Twisp, and Chewuch rivers (Salmonscape 2003; Humling and Snow 2004, 2005). Additional spawning has been documented in Gold Creek, Wolf Creek, Robinson Creek, Lake Creek, and Early Winters Creek (Salmonscape 2003; Humling and Snow 2004, 2005). Hatchery origin spring Chinook returns to natural spawning areas within the Methow basin originate from two separate programs. Winthrop National Fish Hatchery has planted spring Chinook in the Methow basin since 1941 (continuously since 1974). Beginning in 1998, broodstock for this program was shifted to a Methow composite stock. Since 1992, WDFW has operated the Methow Hatchery as a central facility to carry out release programs from acclimation facilities in three tributaries within the Methow River—the Methow, Chewuch and Twisp drainages. Broodstock for the Twisp program are collected from returns to the Twisp system. In recent years, a composite broodstock has been used for the Chewuch and Methow releases. The majority of returns from these programs spawn in their natal watersheds although there has been a relatively high rate of straying among areas within the Methow.

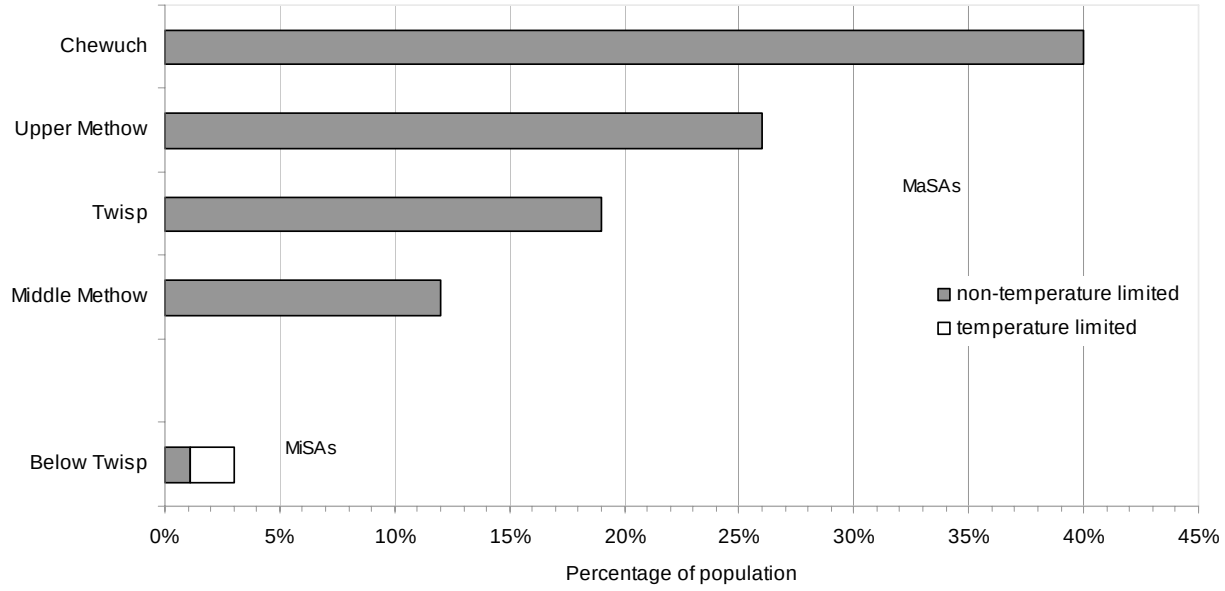

Figure 4. Percentage of historical spawning habitat (of the population) by major/minor spawning area. White bars represent current temperature limited areas that could potentially have had historical temperature limitations.

Factors and Metrics

A.1.a Number and spatial arrangement of spawning areas

The Methow spring Chinook population has four MaSAs (Chewuch, Twisp, Upper Methow, and middle Methow mainstem). Currently, 3 of the 4 MaSAs meet the ICTRT occupancy definition so it is at *low risk*. The MaSA that failed to meet minimum occupancy requirements was the middle Methow mainstem (between the Chewuch and Twisp confluences) that only had more than 4 redds in 3 of the last 5 years and 6 of the last 15 years (Humling and Snow 2005).

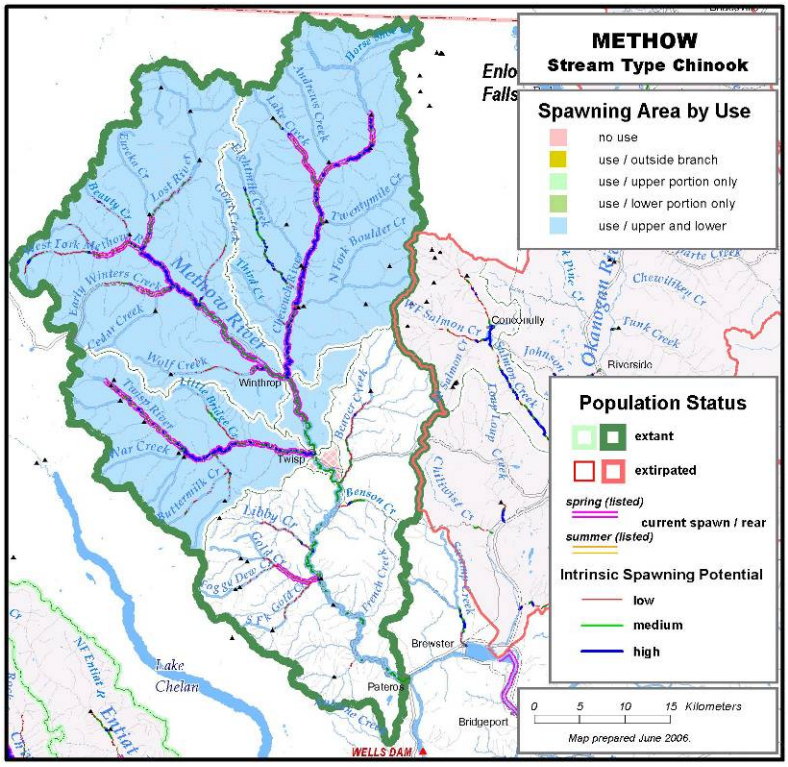

Figure 5. Methow Spring Chinook current distribution

A.l.b. Spatial extent or range of population.

The Methow spring Chinook population has four MaSAs (Chewuch, Twisp, Upper Methow, and middle Methow mainstem) and 75% (3 of 4) of the MaSAs meet the ICTRT occupancy definition so it is at *low risk*.

A.1.c. Increase or decrease in gaps or continuities between spawning areas. There has been no increase or decrease in gaps greater than 10 km between MaSAs for the Methow spring Chinook population so it is at *low risk* for this metric.

B.1.a. Major life history strategies. The Methow spring Chinook population is *very low risk*, because no major life history strategies have been lost.

B.1.b. Phenotypic variation. We do not have data available for this metric. Even if we determined that there was a change to one or more traits we do not know what the exact baseline is because changes likely occurred before there was biological monitoring. Therefore, we will assume that there has been some change and increase in variance for 2 or more traits placing the population at *moderate risk*.

B.1.c. Genetic variation.

The Methow spring Chinook population was determined to be at *high risk* for genetic variation due to a persistent homogenization from previous fish management efforts. Analyses based on allozymes collected in the 1980s suggest that there was some differentiation between subpopulations consistent with the level of differentiation expected in that time frame, particularly in the Twisp drainage. However, microsatellite samples collected in the late 1990s and early 2000s do not show this same differentiation, suggesting that recent management practices may have disrupted natural gene flow (IC-TRT pop id draft, in prep). The ICTRT genetic subgroup has reviewed the current status of all populations in the Interior basin. The subgroup concluded that the Methow population has been homogenized with other UC populations due to past practices. Their conclusion was based on high similarity to all UC hatchery samples and AMOVA analysis indicating no structure. Additionally, the hatchery stocks currently used in the upper Methow and Chewuch programs still contain a large percentage of Carson lineage, and hatchery fish comprise high proportions (40-98%) of fish on the spawning grounds (Humling and Snow 2004), so the threats to genetic variation have not been completely removed. It is possible that the true genetic risk metric for this population is lower. If additional data becomes available indicating differentiation between and within populations (either genetic data indicating levels of divergence consistent with the time since separation; robust straying data, or genetic information showing strong spatial structure), the risk level for this metric could improve to moderate or low risk.

B.2.a. Spawner composition.

(1) *Out-of-ESU strays*. In 2003, there was a 1% spawner composition (Humling and Snow 2004) of hatchery fish from outside the population, but the Methow State Hatchery and the Winthrop National Fish Hatchery are propagating a composite stock that has outside the ESU lineage, so the population is at *moderate risk* for this metric.

(2) *Out of MPG strays*. The Upper Columbia ESU only has one extant MPG, so this metric is *not applicable* and no score will be given.

(3) Out of population strays. Met-comp hatchery fish contain a high proportion of Carson stock in their lineage and cannot be considered "best management practices". These fish consistently comprise more than 90% of the spawner composition on the spawning grounds (Humling and Snow 2005); therefore, the population is at *high risk* with respect to this metric.

(4) *Within-population strays*. This metric is *not applicable* because of the high proportion of Carson lineage in the Metcomp stock that is being propagated for the supplementation program.

B.3.a. Distribution of population across habitat types.

The intrinsic potential distribution for Methow Spring Chinook covered three ecoregions (Table 4). Current distribution also encompasses 3 ecoregions with no losses or substantial shifts in distribution among ecoregions (Table 4). Therefore, the population was at *low risk* for this metric.

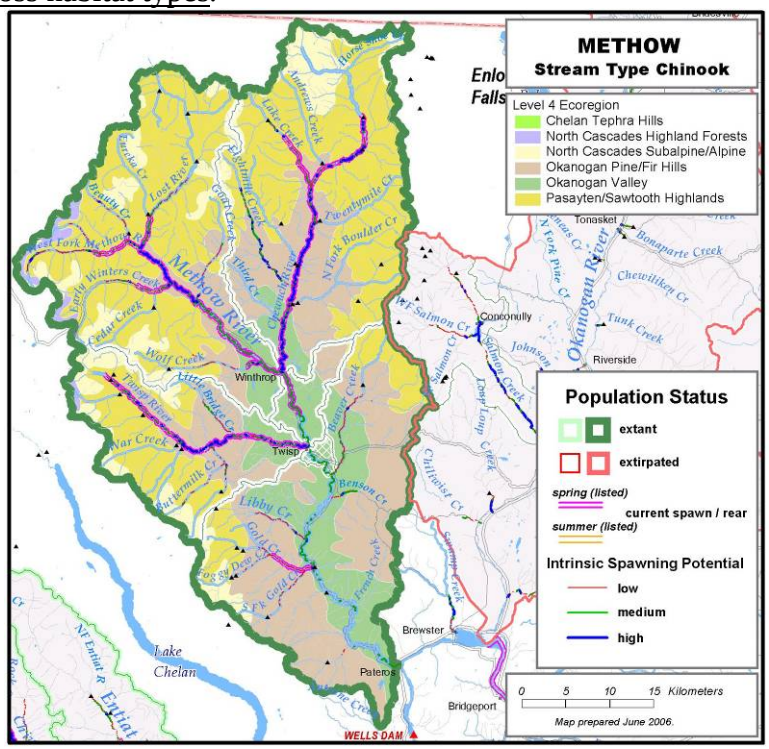

Figure 6. Methow Spring Chinook population distribution across various ecoregions.

Table 3. Methow Spring Chinook – proportion of spawning area across various ecoregions

Ecoregion	% of historical branch spawning area in this ecoregion (non-temperature limited)	% of historical branch spawning area in this ecoregion (temp. limited)	% of currently occupied spawning area in this ecoregion
Okanogan Pine/Fir Hills	44.0	50.3	50.4
Okanogan Valley	45.4	37.6	34.8
Pasayten/Sawtooth Highlands	10.6	12.1	14.8

*Temperature limited areas were assessed by subtracting area where the mean weekly modeled water temperature was greater than 22°C.

B.4.a. Selective change in natural processes or selective impacts.

Hydropower system: The hydropower system and associated reservoirs impose some selective mortality on smolt out migrants and upstream migrating adults. The hydrosystem has slowed out migration for early and late out migrants; however, in recent years flow augmentation has reduced the impact to the middle 95% of the run. Additional selective pressures of the hydrosystem that warrant further evaluation to rate this metric include size selective predation by piscivores (Baldwin et al. 2003; Fritz and Pearsons 2006) and size-based differential passage mortality through the hydro projects. The magnitude of selective mortality and the proportion of

the population that is affected are unknown. The selective mortality is not likely to remove more than 25% of the affected individuals, thus we have rated this metric as *low risk*. However, a quantitative assessment using empirical data was not conducted, so there was considerable uncertainty in the conclusion that there are not selective pressures acting on the population that warrant a higher risk rating. When additional information is available this component of selectivity should be re-evaluated.

Harvest: Low risk in recent generations. Harvest rates effect < 20% of the adults and selective gear reduces the impact of selectivity.

Hatcheries: Low risk; The Methow River Spring Chinook hatchery programs take broodstock from the run at large so there are not selective pressures on run timing or age structure.

Habitat: Moderate risk; low flow and high temperatures due to water withdrawals in some important areas such as the Twisp and Chewuch could effect run timing for late arriving adults and rearing locations for juveniles. It is uncertain if this affects more than 25% of the individuals from the selected component and this component of selectivity should be re-evaluated.

With a moderate risk rating in one of the four sectors, this metric is at *moderate risk.*

Spatial Structure and Diversity Summary.

The Methow spring Chinook population was determined to be at low risk for goal A (allowing natural rates and levels of spatially mediated processes) but high risk for goal B (maintaining natural levels of variation) resulting in an overall high risk rating. The metric for genotypic variation was directly responsible for the high risk rating of Methow spring Chinook. For B.1.b. (phenotypic variation) to improve from moderate to low risk, an analysis needs to be conducted that shows that the phenotypic traits of the current population are consistent with the assumed historical condition or with unaltered reference populations in a similar habitat, geologic, and hydrologic setting.

There was one metric that was rated at high risk related to spawner composition (B.2.a.3.) that did not directly reduce the overall risk conclusion, but should be considered a potential threat to both genotypic (B.1.3) and phenotypic variation (B.1.b). Met-comp hatchery fish contain a high proportion of Carson stock in their lineage and cannot be considered “within population” hatchery fish for the spawner composition metric. These fish consistently comprise more than 90% of the spawner composition on the spawning grounds (Humling and Snow 2005). However, due to the scoring system this high-risk rating was averaged in with other metrics and did not directly cause an increased risk rating.

Table 4. Spatial structure and diversity scoring table

Metric	Risk Assessment Scores				
	Metric	Factor	Mechanism	Goal	Population
A.1.a	L (1)	L (1)	Low Risk Mean = 1	Low Risk	**High Risk**
A.1.b	L (1)	L (1)			
A.1.c	L (1)	L (1)			
B.1.a	VL (2)	VL (2)	High Risk (-1)	High Risk	
B.1.b	M (0)	M (0)			
B.1.c	H(-1)	(H-1)			
B.2.a(1)	M (0)	High Risk (-1)	High Risk (-1)		
B.2.a(2)	NA				
B.2.a(3)	H (-1)				
B.2.a(4)	NA				
B.3.a	M (0)	M (0)	M (0)		
B.4.a	M (0)	M (0)	M (0)		

Overall Risk Rating:

The Methow spring Chinook population is not currently meeting viability criteria. Of particular concern is the high risk rating with respect to abundance and productivity. The population cannot achieve any level of viability without improving its status on the viability curve for both abundance and productivity. Spatial structure and diversity was also rated as high risk. Improvement of the spatial structure and diversity status to low risk would be required to allow the Methow population to achieve a "highly viable" status (in addition to the improvements needed for abundance and productivity). Based on the MPG guidelines, the Methow population will need to achieve a highly viable status for recovery of the ESU (ICTRT 2005).

		Spatial Structure/Diversity Risk			
		Very Low	**Low**	**Moderate**	**High**
Abundance/ Productivity Risk	**Very Low** (<1%)	HV	HV	V	M
	Low (1-5%)	V	V	V	M
	Moderate (6 – 25%)	M	M	M	
	High (>25%)				Methow River

Figure 7. Viable Salmonid Population parameter risk ratings for the Methow River Spring/Summer Chinook salmon population. This population does not currently meet viability criteria. ***Viability Key: HV – Highly Viable; V – Viable; M – Maintained; Shaded cells-- not meeting viability criteria.***

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Methow Spring Chinook – Data Summary

Data type: Methow Spring Chinook (without Icicle Creek). Redd count expansions (added wild broodstock)

SAR: Expanded Chiwawa SAR index

Table 5. Methow Spring Chinook run data (used for Poptools curve fits). Entries used in the productivity calculation are bolded.

Brood Year	Spawners	%Wild	Natural Run	Nat. Rtns	R/S	Rel. SAR	Adj. Rtns	adj R/S
1979	**524**	**0.95**	**499**	**480**	**0.92**	**1.32**	**635**	**1.21**
1980	**438**	**0.91**	**399**	**1064**	**2.43**	**0.80**	**847**	**1.93**
1981	**467**	**0.79**	**367**	**735**	**1.57**	**0.74**	**541**	**1.16**
1982	**558**	**0.73**	**408**	**1355**	**2.43**	**0.72**	**973**	**1.74**
1983	**861**	**0.78**	**672**	**1190**	**1.38**	**0.80**	**954**	**1.11**
1984	**929**	**0.86**	**801**	**1167**	**1.26**	**1.36**	**1591**	**1.71**
1985	**1232**	**0.76**	**932**	**1081**	**0.88**	**1.34**	**1447**	**1.17**
1986	**909**	**0.77**	**700**	**733**	**0.81**	**1.80**	**1320**	**1.45**
1987	**1496**	**0.90**	**1347**	**726**	**0.49**	**1.48**	**1073**	**0.72**
1988	1641	0.80	1309	1963	1.20	0.73	1426	0.87
1989	**1144**	**0.96**	**1095**	**668**	**0.58**	**1.27**	**850**	**0.74**
1990	**1104**	**0.97**	**1074**	**59**	**0.05**	**3.12**	**184**	**0.17**
1991	**550**	**0.96**	**527**	**78**	**0.14**	**7.30**	**567**	**1.03**
1992	1630	0.95	1547	173	0.11	5.21	904	0.55
1993	**1357**	**0.87**	**1179**	**206**	**0.15**	**0.49**	**101**	**0.07**
1994	**293**	**0.96**	**282**	**145**	**0.49**	**1.92**	**278**	**0.95**
1995	**33**	**0.89**	**30**	**172**	**5.21**	**0.41**	**71**	**2.16**
1996			126	822				
1997	**339**	**0.70**	**265**	**1289**	**3.80**	**0.15**	**193**	**0.57**
1998			125	588				
1999	79	0.82	143					
2000	805	0.27	227					
2001	9904	0.19	1870					
2002	2622	0.27	708					
2003	1047	0.08	84					

Table 6. Geomean abundance and productivity estimates. Current abundance and productivity values are boxed.

	R/S measures				Lambda measures		Abundance
	Not adjusted		SAR adjusted		Not adjusted		
delimited	median	75% threshold	median	75% threshold	1987-1998	1979-1998	Nat. origin geomean
Point Est.	1.36	0.81	1.24	0.88	1.08	1.10	205
Std. Err.	0.42	0.31	0.16	0.22	1.58	0.84	0.36
count	10	16	10	16	12	20	10

Table 7. Poptools stock-recruitment curve fit parameter estimates. Productivity values and standard errors determined to be out of bounds are highlighted.

	Not adjusted for SAR							Adjusted for SAR						
SR Model	a	SE	b	SE	adj. var	auto	AICc	a	SE	b	SE	adj. var	auto	AICc
Rand-Walk	0.74	0.21	n/a	n/a	0.84	0.67	63.3	0.85	0.17	n/a	n/a	0.67	0.15	48.9
Const. Rec	491	120	n/a	n/a	n/a	n/a	57.4	569	123	n/a	n/a	n/a	n/a	52.9
Bev-Holt	7.73	10.33	578	179	0.58	0.66	59.1	2.16	1.26	1093	487	0.50	0.24	47.3
Hock-Stk	5.21	5.42	100	107	0.59	0.65	59.2	1.24	0.32	611	208	0.51	0.13	46.9
Ricker	2.50	1.26	0.00142	0.00051	0.73	0.56	59.9	1.75	0.62	0.00083	0.00036	0.51	0.18	47.2

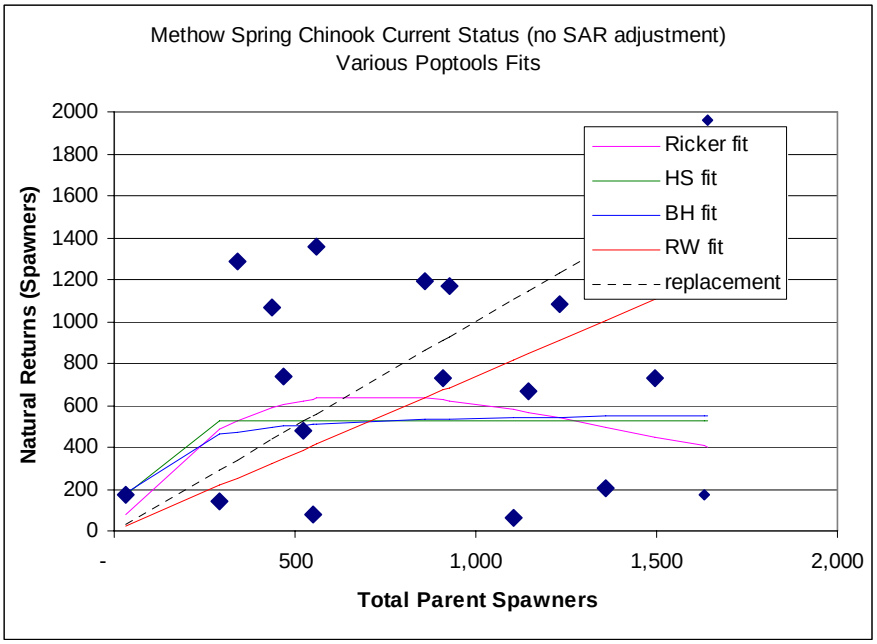

Figure 8. Methow Spring Chinook stock-recruitment curves for the most recent 20-year data series. No adjustment was made for marine survival. Data points used in the productivity calculation are bolded.

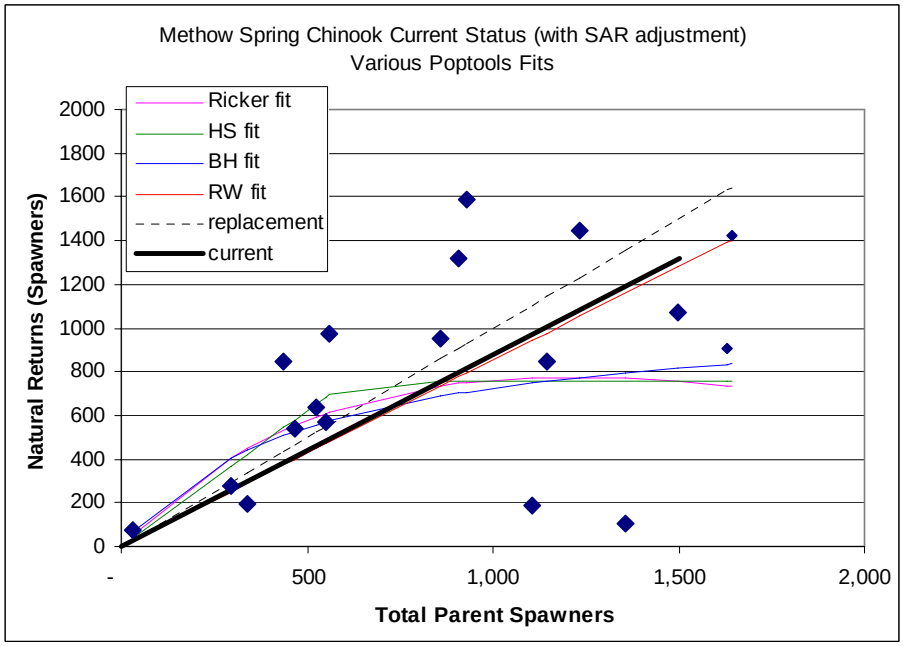

Figure 9. Methow Spring Chinook stock-recruitment curves for the most recent 20-year data series. An adjustment was made for marine survival. Data points used in the productivity calculation are bolded.